Water Storage for Food Security in Nepal

Khem Raj Sharma

Abstract: Increasing trend of water scarcity for drinking, irrigation, hydropower generation and other purposes has been a serious challenge for Nepal. As food need rises, the country's reliance on irrigated agriculture increases. The existing run-of-river types of irrigation systems provide little leverage in providing adequate, timely and equitable water supply to the farmers' fields. With the approval of the 2002 Water Resources Strategy, the country is in the process of changing its water development paradigm from sectoral to integrated water resource management. In this context, intensification of agriculture is the most viable option of achieving food security and this requires assured supply of irrigation water which is possible mainly through water storage systems.

Key words: Integrated Water Resources Management (IWRM), irrigation, water storage, agriculture intensification, Nepal

Background

Storage systems are meant for the purpose of impounding water or creating a reservoir for several purposes including raising water level, diverting water into a conduit or canal, creating a hydraulic head which can be used to generate power, improving river navigability by means of regulated releases of stored water, and retaining sediment. The storage systems have, therefore, an important role to play in the management of water resources for irrigation, hydropower generation, flood control, industry and households. The storage systems include simple indigenous structures (such as *zabo* in Nagaland, India; *aahal, kuwa, pokhari, hiti* or *dhunge dhara* in Nepal; *johad* in Rajasthan, India; or aahar pyne and pat in Bihar, India; *karez* in Pakistan; *jessour* in Tunisia; *tanks* in Sri Lanka and Tamilnadu in India; small farm reservoir in the Philippines, etc.), as well as large reservoirs with small or large dams. The hydropower generation from the Indrasarobar of Kulekhani Hydroelectric Power Project is a good example what a reservoir can contribute in the field of water resources management. In many parts of the world, such plants are instrumental to the economic upliftment of the nation. Likewise significant contributions from the indigenous water impounding structures are reported from several countries all over the world.

Water issues have been complex, resulting from population growth and changes in technology, land use, ecosystems and climate. Climate change, in particular, is projected to have severe adverse effects on water availability with overall changes in precipitation patterns (Vaidya 2010). Escalated levels of spatial and temporal variations in precipitation with the average total increasing or decreasing in various locations and time have been reported in the recent past. The monsoon in the South and Southeast Asia region is witnessed to have shorter duration but of higher intensity resulting in a higher incidence and intensity of floods in the river basins and a higher proportion of runoff. Consequently, there is reduction in groundwater recharge. This will eventually lead to the reduction of underground water storage which will have adverse impact on the lean season surface and groundwater availability for drinking, irrigation and other uses. In the food sector this has come at a time when concerted efforts have to be made to substantially increase the agricultural productivity to meet the ever increasing demand for more food products.

The Rationale for Storage Systems

The focus of the paper is on food security and the role of water storage systems. Statistics of Nepal's water resources reveal that the amount of fresh water currently available per person per year is in the order of over 8,100m^3, which far exceeds the water availability in neighboring China (2,300m^3), India (2,000m^3) and Pakistan (1,700 m^3). The amount of water needed to produce the food required for a balanced diet per person per year is around 2,000 m^3, which indicates that Nepal has several times more water availability than its requirements. Because these statistics are based on annual flows, however, they carry little meaning in terms of use, because about 80% of the rainfall occurs in the monsoon period and most of it flows out as runoff. For more realistic calculations, monthly river hydrographs with their probabilities are the better indicators. The hydrographs of several rivers/streams in the non-raining months are too low as compared to the peak flows in the monsoon months.

This scenario of reduced river flows in the dry season does not support intensive irrigated cropping and generally only one crop in the monsoon season is irrigated. In the Nepal case, however, the increased production to satisfy the food demand of the future must come from intensification, not from expansion of agricultural area. An estimate suggests that by the year 2025/26, Nepal's population will be around 41 million and the corresponding grain requirement will be 11.45 million tons. By comparison, the current population is 28 million, and the current level of food grain production is said to be around 7.14 million tons. The intensification potential of irrigated agriculture is much higher as compared with the rainfed agriculture. In the countries where there are water storage reservoirs for irrigation, a perennial supply of water can be assured and up to three crops are harvested annually with significant economic achievements. The reservoir systems ensure dependable year-round irrigation facilities with increased land productivity. Furthermore, this helps minimize the risk of crop failure due to dry spells and makes available nutrients more effective to the crops by providing suitable microclimate.

Evidence shows that crop yields from irrigated areas that receive water on demand are far more than those of seasonal canal systems. When there is assured irrigation, farmers are willing to make full investment in productive inputs and harvest the maximum yields. In addition, the provision of reservoir systems helps extend irrigation to new command areas and contributes to increasing the cropping intensities. As an example, the proposed Sapta Gandaki Multipurpose Project could provide year round irrigation to agricultural lands in Chitwan, Nawalparasi and Rupandehi Districts of Nepal. The irrigation-led reservoir project, along with other benefits, will be generating hydroelectricity as well.

As the importance of irrigation water in increasing and sustaining agricultural production lies not only on its productivity but also on its ability to increase the contribution of other growth factors like improved seeds and chemical fertilizer, the degree of control that an irrigation system allows for is of utmost significance. This is the reason why water storage is regarded as a major component in an irrigation system. Storage facilities such as reservoirs and dams can also serve as insurance for uncertainties.

The Existing Irrigation Facilities

The irrigation systems in Nepal are mainly of the run-of-river types which provide little leverage to controlled water in the canals. Rotational method of water distribution during lean flows is usually practiced and in the absence of water storage facilities, irrigation water distribution is supply driven meaning that it is not possible to provide required flow during the time of demand. Rotational system of water distribution is viable in the irrigation system having reservoir facilities. Scheduled delivery is assured only when there is storage facility. Seasonal employment in farming is a cause of rural poverty. Unless there is irrigation facility supporting at least two crops in a year the rural population remains not fully employed in their farming and the cost of opportunity elsewhere is minimal. In such a situation the availability of perennial supply of irrigation water with reservoir facility will certainly be a promising development. Shifts in cropping pattern can be made and high value cash crops can be planted depending on the marketing opportunities. This will also facilitate in the supply of measured flow and price the water which will help generate local resources that can be used for sustainable system management.

Unless the irrigation facilities are able to promote intensive cropping engaging the farmers actively for considerable period in a year, the envisaged benefits in agriculture cannot be realized. Rural population will continue looking for better employment opportunities which are not readily available. Year round dependable irrigation with appropriate dams/ storage facilities needs to be seriously considered in our future planning.

Water Storage Systems

The water storage systems in general include either natural systems or constructed reservoirs. Soil moisture is the most prevalent system of natural water storage. Watershed management by means of improved land cover and water conservation techniques is instrumental to rainwater harvesting and soil moisture storage. This can eventually lead to increased soil infiltration capacity to recharge groundwater. The average annual rainfall in the country is over 1500 millimeters. The total volume of water including rain and snow is 270 billion cubic meters. Part of this water evaporates, part of it percolates down contributing to groundwater recharge, and considerable percentage of it flows as surface runoff. One estimate suggests that about 210 billion cubic meters of water from Nepal flows to River Ganges in India. Some 10 to 20% of the total water finds its way towards groundwater recharge (Dixit, Upadhya and A. Tamrakar 2006).

Reservoirs constructed with varying degrees of water storage capacity have good potential for providing assured supply of water on demand basis. Small and large reservoirs could be constructed for sectoral or multipurpose use. The international donor agencies are rather skeptical in funding the sizable dam projects for the reasons that several projects in many countries are accused of corruption, failure to compensate displaced people, and environmental problems. A few years back, on the behest of developed countries, a Commission on Dams was established with a mandate of reviewing the whole issue of dam construction. The commission's report (WCD 2000) has prescribed several conditions for dam construction that are not favorable to the least developed countries who look for outside support for constructing sizable water projects. For example, the standard definition of small dams is for structures less than 15 meters high with an embankment volume less than 0.75 million cubic meters. For Nepal we need also to go for several structures of larger size; hence, we have to look for international funding for the construction of dam projects. Following the commission's report availing international support for large dams is not that simple.

The Way forward

The politicians and planners need to focus more on providing water services for drinking water, irrigation, and hydropower generation, industrial or any other use. What is required is to develop a consensus for fixing the country's priorities for developing water resource projects and to come forward with convincing arguments that support our national development vision. The issue of water storage facilities, especially for irrigation or irrigation-led multipurpose projects is of prime importance in the present context because the country has already a Water Resource Strategy, 2002 and National Water Plan, 2005 (WECS 2002, 2005) which prescribe the adoption of the principles of Integrated Water Resources Management (IWRM) (Molinga, Dixit and Athukorala 2006).

Besides surface and ground waters, rainwater is the major source of water that should be considered for storage. Depending on the specific sites, small or large rainfall harvesting systems can be built. Small reservoirs, in many instances, are relatively cost effective and can be built in a shorter time frame. Also of significant importance is the need to explore, revive and improve on indigenous techniques of water storage that have been locally adapted and are more cost effective.

Sedimentation is a big challenge in water storage systems. The sedimentation problem in Kulekhani Reservoir in Nepal, for example, has considerably reduced its water storage capacity. To address this problem, watershed management and planning based on IWRM principles with local community support is essential. The concept of Payment on Environmental Services (PES) where the hydropower project compensates the upstream dwellers for their role in conserving the upper watersheds which is instrumental in reducing the sediment load in the reservoir has been introduced (Karki and Joshi,2010). This participatory approach needs to be promoted in all water storage projects, bringing together the upstream and downstream communities whereby the downstream people compensate the upstream people for their role in watershed conservation.

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